

APPENDIX E

**GEOLOGY AND ENVIRONMENT
SUNFLOWER ARMY AMMUNITION PLANT**



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The Sunflower Army Ammunition Plant is located in the Attenuated Drift Border that represents a glaciated portion of the Dissected Till Plains and the Osage Cuestas physiographic subprovince (O'Connor 1971:4; Schoewe 1949). The Attenuated Drift Border forms a 25-mile-wide area on both sides of the Kansas River. This late Pleistocene feature is represented by deep, wind-blown loess deposits and isolated patches of glacial till, erratics, and cobbles and pebbles (Denne 1979; Hoover 1936; Logan 1990:3; O'Connor and Fowler 1964:630).

The deep bedrock geology of the area is characterized by alternating strata of upper Pennsylvanian and lower Permian limestones and shales of the Lansing Group, and Bonner Springs shale and Wyandotte limestone of the Kansas City Group (Kansas Geological Survey 1982; O'Connor 1971). The Captain Creek limestone member of the Lansing Group occurs in northwestern Johnson County and is reported to contain small quantities of pink and gray chert nodules. The cherts may have provided prehistoric aboriginal populations with a suitable source of isotropic (tool quality) stone for the production of stone tools. However, no prehistoric quarries have been identified in the immediate vicinity of SFAAP.

Among the deep Pennsylvanian formations, about 600 feet beneath portions of Johnson County, are "Squirrel sandstone" and "Bartlesville sandstone" of the Cherokee Group and sandstones of the Marmaton Group reportedly contain oil and gas. The "Knobtown sandstone" of the lower Pleasanton Group contains gas. According to O'Connor (1971:5-6), the Nomenclature Committee of the Kansas Geological Society has designated 10 named areas of oil and gas production in the county including areas within SFAAP. However, several of the gas fields are abandoned or produce noncommercial amounts of gas. No plans for oil or natural gas production are scheduled for SFAAP.

The surficial geology of the SFAAP area is generally characterized by undifferentiated fluvial (stream) and lacustrine (stream bank) deposits, Kansan till, and the Atchison Formation consisting of clays, silts, sands, and gravels resulting from glacial outwash deposition (Hoover 1936; Kansas Geological Survey 1982; U.S. Department of Agriculture, Soil Conservation Service [USDA, SCS] 1979). Area soils are primarily related to the Woodson-Pawnee soil series consisting of deep, moderately well drained and somewhat poorly drained, gently sloping and moderately sloping soils that have a loamy or clayey subsoil found on uplands (USDA, SCS 1979). These soils were formed in glacial till and old alluvium. The Woodson soils are

dominant throughout the relatively level uplands of SFAAP, and the Orthents, Pawnee, Martin, Morril, Sogn, and Chase soils dominate the slopes and lower floodplains.

Prehistoric archeological sites that have been recorded on the facility occur on soils of the Kennebec, Reading, and Morril series. Future archeological survey is likely to find additional soil types containing prehistoric and historic cultural deposits. Kennebec silt loam, a deep, moderately well drained, and moderately permeable soil, is formed from alluvium on bottom lands; the Reading silt loam consisting of deep, well drained, and moderately slow permeable soils is found on stream terraces formed from alluvium; and the Morril silt loam consisting of deep, well drained, and moderately slow permeable soils is formed in glacial till that occurs on uplands on three to eight percent slopes (USDA, SCS 1979). Potential deeply buried cultural deposits may be anticipated in Kennebec, Reading, and other soils of the floodplain vicinity. As discussed in the prehistoric overview, deeply buried Paleo-Indian, Archaic, and Woodland cultural deposits have been found from one to several meters below the modern surface in similar geographical settings (Katz 1971, 1973; Kopsick 1982; Schmits 1980; Schmits and Bailey 1986).

The topography of SFAAP is gently rolling and undulating uplands with an elevation that ranges from 770 feet at the northeastern corner to a maximum of 960 feet in the south-central portion. The facility is drained by two high order perennial drainages with moderate to deeply incised valleys that lead northward to the Kansas River about two miles from the facility. Kill Creek on the east perimeter is joined by Spoon Creek in the southeastern corner of the facility. Captain Creek parallels the western perimeter.

With regard to vegetation communities, SFAAP falls within the tall-grass prairie province (Audubon Society 1989; USDA 1980). This region was historically characterized by tall- and mixed-grass prairie vegetation communities and oak-hickory forest along the timbered floodplain areas (Hercules 1993; Self 1978). Today the tall-grass prairie forbs and grasses have been replaced by introduced species. Historically introduced species of trees are also found. Mature examples of introduced red cedar may be almost exclusive to some of the historic farmsteads. A brief inspection of several known sites found that many historic sites were re-landscaped when SFAAP was erected. In some cases the landscaping left little or no architectural surface remains. In these cases the mature red cedar may represent the only surface indications of former settlement. Information is needed to determine whether the landscaping compromised the integrity of the archeological deposits. A complete listing of trees, shrubs, and weeds and grasses that occur on SFAAP is presented in Hercules' (1993:10-14) *Natural Resources Management Plan*. Mammals recently reported within the facility include fox squirrel, gray squirrel, muskrat, eastern cottontail, raccoon, and white-tailed deer. Among the common birds are bobwhite, quail, and mourning dove. Reptiles and amphibians include bullfrog, leopard frog, and snapping turtle.

CHANGES IN THE LAND

Pollen spectra from the region indicate that about 23,000 B.C. the landscape was dominated by spruce forest throughout northeastern Kansas. The last glacial advance of the Wisconsin period was about 16,000 B.C. when the maximum cold conditions dominated. Eventually the climate began to warm and between 13,000 B.C. and 9340 B.C. the spruce populations were reduced and gradually replaced with oak, hickory, ash, hornbeam, and maple. By 7900 B.C., a decrease in tree pollens is noted with an increase in ragweed pollens indicating a shrinking of the forests and an advance of the prairie environs. From 6700 B.C. to about 3100 B.C., the entire region was in a drought phase (King 1980). During the dry period, the prairie environs extended eastward until increased precipitation supported the forest species, and the prairie/forest border again moved westward. Since that time the environs have been similar to today with a mosaic of forests concentrating along drainages separated by islands of prairie.

One of the earliest descriptions of the environment in the immediate SFAAP vicinity was written by an anonymous traveler in May 1849:

May 11th, 1849. Our course to-day has been over the rolling prairie, and we passed along without difficulty. The prairie seems to be an endless succession of rolls, with a smooth, green surface, dotted all over with most beautiful flowers. The soil is of the most rich and fertile character, with no waste land. The feelings that come over a person, as he first views this immense ocean of land, are indescribable. As far as the eye can reach, he sees nothing but a beautiful green carpet, save here and there perhaps a cluster of trees; he hears nothing but a solemn awe in view of this infinite display of creative power.

13th. Turned out this morning at four o'clock, to watch the cattle. Went upon a high roll of land, where I had an extensive and enchanting view of this seemingly boundless and ever varying prairie. The sun is rising out of this sea of land in the east, a line of timber skirts *Cedar Creek* to the NE, also *Spoon Creek* to the NW, while still further on, in the same direction, constitutes the base; the loud cawing of the crows, the tenor; the fine sweet voices of the ground and small birds, the treble; and a noise as of distant wild geese, the alto (emphasis added) [Hale 1854:122].

Important alterations in the landscape that have occurred since historic settlement (1850s) include the decrease in prairie fires caused by the elimination of Native American burning of lands; the conversion of prairie to agricultural fields; the development of towns and cities, and the collective broken landscape that has created discontinuous grasslands for the fires to burn through (Audubon Society 1989). The Pawnee and other tribes often burned the prairie in the fall and occasionally during the spring increasing grasses for forage to support their horses (White 1982) and bison (Audubon Society 1989:50). The practice of burning the landscape had been recorded elsewhere in the United States by early explorers and settlers (New England [Cronon 1983] and California [Lewis 1973]) and is reviewed elsewhere by Stewart (1951). In woodlands areas, fire served to thin the forest canopy promoting the growth of smaller plants; warmed and dried the soils encouraging drier species such as oak; and decreased plant disease, pests, and fleas. The resulting increase in the herbivorous food supply in turn increased populations of elk, deer, beaver, hare, porcupine, turkey, grouse, and others, and ultimately their predators including raptors, cats, foxes, coyotes, and wolves (Cronon 1983:51). The intention of prairie burning by Plains tribes may have been slightly different than it was in the more wooded interior and coastal settings. White (1982:37) emphasizes that burning the plains primarily served to accelerate the soil's replenishment of nutrients for prairie grasses, thereby requiring less travel for forage near the summer villages. The Audubon Society stresses that fire was used to drive bison during a kill or to attract them with fresh grass. In either case, the near elimination of the wild prairie fires has been a factor in the replacement of the open prairie with forested environs as the eastern woodlands slowly migrates westward (Audubon Society 1989).



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